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ABSTRACT

The two logical notions of intension and extension are examined and applied to examples of Chinese words. Intension and extension are comparable to "sense" and "reference." It is found that they are not only useful in explaining certain problems concerning meaning, but also cogent in building a formal semantic structure parallel to formal syntax as represented by categorical grammar. It is suggested that some problems remain, such as the fact that these notions seem to deal only with declarative sentences. A need is seen for explanations for idiomatic usages that cannot be accounted for in terms of the Fregean principle, as well as for contextual situations turning a normal sentence into a satirical one. However, intensional grammar is seen as an important first step in its provision of a formal semantic structure. (Author/MSE)

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INTENSIONS AND EXTENSIONS OF CHINESE WORDS

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1. INTRODUCTION

The two logical notions, intension and extension, have been developed only in the past century by philosophers and logicians in coping with problems involving meaning. Frege (1892) suggested that a distinction should be made between "sense" and "reference", which are more or less equivalent to today's terms, intension and extension. Subsequently, Carnap (1947), Church (1956), Kalish (1967), Lewis (1971), and others added their nuances. The two notions were originally used only in connection with general terms, i.e. terms that can apply to several different objects. For example, the word "flower" designates a large set of objects, its extension, by means of its intension, which could be described as the concept created through an act of abstraction over the properties that all flowers have in common. Later, the distinction was generalized by Carnap to apply to singular terms as well. More recently, their usages have been extended to cover predicates as well as sentences. Now we take individuals as the extension of names, sets of individuals as the extension of predicates and truth-values as the extension of sentences. An intension, on the other hand, is something that relates a linguistic expression to its extension. Thus an intension can be viewed as a function: something that for every possible world picks out exactly those objects

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which make up the extension of a given expression there. More recently, Montague (1974) suggested that all expressions of derived categories have as their extension a function from the intension of the argument of the functional category. In other words, the extension of functional categories are now always functions from intensions to extensions. This bold suggestion, integrated with categorial grammar, has enabled Montague to formulate the first formal semantic theory based on Fregean Principle (also known as the Principle of Compositionality). What needs to be clarified is the newly-enlarged role of intension, which is now used extensionally in all contexts.

With such background in mind, we have set two modest goals for this paper: 1) To justify the need for intension and extension in dealing with problems involving meaning; and 2) to define and clarify the two terms by applying them to Chinese, a non-Indo-European language, and see if all these new claims are justifiable. Other related problems will also be discussed.

2. INTENSION AND EXTENSION

Both linguists and philosophers are interested in the study of language. While linguists emphasize the structural aspects of language, philosophers are more interested in finding out how linguistic expressions are related to things in the actual world. Thus a sharp distinction between the philosophical and linguistic tradition in semantics can be seen in the emphasis or lack of it on the notion of truth. Tarski (1944) introduced the idea of giving explicitly a truth condition as applied to the sentences of a language L. The truth condition is something like this:

(1) X is true if and only if p

where X stands for a declarative sentence of language L, and p is replaced by a translation of the sentence, which, in this case, is the sentence itself, for example:

(2) "Grass is green" is true if and only if grass is green.

We may thus interpret this claim as saying that from any correct characterization of truth conditions, of the form "Sentence S is true if and only if p," we can derive a correct characterization of meaning, of the form "Sentence S means that p."

Immediately a problem arises. The "if and only if" in (1) is generally taken to express MATERIAL EQUIVALENCE, and a statement of material equivalence is true just in case the sentences that flank the "if and only if" have the same truth value. Thus given the fact that snow is white, the truth conditions for that sentence can be correctly expressed by the statement: "The sentence 'snow is white' is true if and only if snow is white." By material equivalence, I will then get another statement, "The sentence 'snow is white' is true if and only if 'grass is green'." This way we would be committed not only to the true claim that snow is white means that snow is white, but also to the false claim that snow is white means that grass is green.

Here, the notions of intension and extension come to the rescue. If the extensions of sentences are truth-values and if the intensions of sentences are functions from possible worlds to truth-values, then we can claim that the two sentences, "snow is white" and "grass is green"

have the same extension (since both "snow is white" and "grass is green" are true in this world) but different intensions, for "snow is white" certainly does not mean "grass is green."

A stronger case for the need of intension may be made out of a classical logical paradox. The example is known as the Electra paradox, and the scenario is the following: Orestes has come home. Electra does not recognize him, although she knows that Orestes is her brother.

(3) The Electra Paradox

Premides: (a) Electra does not know that the man in front of her is her brother.

(b) Electra knows that Orestes is her brother.

(c) The man in front of her is identical to Orestes.

Conclusion: Electra both knows and does not know that the same man is her brother.

The conclusion is obviously a contradictory statement. The usual way out of this type of paradox is to assume a third type of entity besides linguistic expressions and objects in the world --- senses or what we call intensions here. Now if we look more closely at the premises that led to this conclusion we find that in (3)a and (3)b we have used two different linguistic expressions to designate this person, viz. Orestes and the man in front of her. Although these two expressions refer to the same individual, they do not have the same sense. In other words, they have the same extension but different intensions. Thus the conclusion is illegitimate.

3. THE CHINESE EXAMPLES

After the brief discussion above to justify the need for the notion of intension, we now turn to Chinese examples. We begin with the logically prior notion of extension. Consider the various expressions in (4) below:

(4) a. Zhang Guo-ming 'name of a person'

b. daxuesheng 'college student'

c. youqian 'rich'

d. Zhang Guo-ming you yige che. 'Zhang Guo-ming has a car.'

where you will find a proper name, a common noun, a one-place predicate, and a sentence, respectively. The extension of those expressions in (4) vary accordingly. The extension of an individual constant is the individual designated by that constant. Thus, the extension of the expression of "Zhang Guo-ming" would be the person referred to by that name. The extension of a common noun is the set of individuals who share the same property or properties as indicated by that common noun. Thus the extension of "daxuesheng" would be those individuals who are commonly called "daxuesheng". "youqian" in (4)c, on the other hand, is a one-place predicate which indicates a property rather than a person. A standard move is to construe properties extensionally, i.e. to individuate them by reference to the set of individuals who have the property. Thus the extension of "youqian" would be those individuals who possess the property. This treatment of the one-place predicate extends to all other types of predicates as well, such as two-place predicates, etc. And finally, the extension of a sentence in a possible world is its truth value in that

world. In (4)d the sentence, "Zhang Guo-ming you yige che 'Zhang Guo-ming has a car'" is true if and only if "Zhang Guo-ming you yige che."

We have so far taken the extension of an expression to be what it applies to in the real world. However, we have to complicate things a little more to do justice to some of the intuitions that motivated logicians to introduce the distinction between intension and extension. According to the Fregean principle, the extension of a complex expression should be derivable from the extension of its parts. Let us therefore see what happens to the principle in an intensional context.

(5) Zhang San zai xiang tade weilaide taitai.
'Zhang San is thinking of his future wife.'

(6) Zhang San zai de tade weilaide taitai.
'Zhang San is beating his future wife.'

There is one reading of (5) in which the predicate "xiang" can be regarded as a relation between individuals. Sentence (5) would in this reading be true if and only if "Zhang San" and "his future wife" are to be found among the pairs of individuals who constitute the extension of "xiang". But there is another reading of (5) in which the sentence can be true even if no individual in our world really is "Zhang San's future wife". "Zhang San" could just have in mind the type of woman he would want for a future wife. This type of interpretation is completely impossible in (6), where "Zhang San's future wife" must exist in our world if the sentence is to be true. Can the Fregean principle be maintained? The solution is the one Frege himself suggested. Some linguistic expressions in some contexts do not have what would normally be their extension as extension; instead they have what would normally be their intension as extension. This means

that the predicate "xiang" can provide both an extensional context (in the first reading, where it designates a relation between individuals) and an intensional context (in the second reading, where it designates a relation between an individual and an individual concept). So what "Zhang San's future wife" designates in the second reading of (5) is an individual concept, not an individual.

In set theory there is a general principle which is called the principle of extensionality and which claims the following: for two sets to be distinct from each other, there must be at least one thing that is an element of one of them and not of the other. The idea of the principle of extensionality is that one entirely disregards the ways in which the members of a set have been chosen. Thus Searle (1978) labelled the principle as the law of substitutibility of identicals. Now consider the following inference.

(7) Zhang San shi Zhongwen xishuren.
'Zhang San is the chairman of the Chinese Department.'

(8) Zhang San you sange haizi.
'Zhang San has three children.'

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(9) Zhongwen xishuren you sange haizi.
'The chairman of the Chinese Department has three children.'

Since "Zhang San" and "Zhongwen xishuren" are the same person, it ought to be the case that whatever is true of one of them is true of the other. Therefore, it is generally possible to substitute the term "Zhang San" with "Zhongwen xishuren" and vice versa without changing the truth-value of the sentence. But there are cases where this principle seems to lead

us astray. Consider the following inference.

(10) Zhongwen xishuren shi Zhang Guo-ming.
'The chairman of the Chinese Department is Zhang Guo-ming.'

(11) Zhongwen xishuren ye keneng shi bieren.
'The chairman of the Chinese Department could have been someone else.'

---

(12) Zhang Guo-ming ye keneng shi bieren.
'Zhang Guo-ming could have been someone else.'

Clearly, (12) does not follow from (11) since "Zhang Guo-ming cannot possibly be someone other than "Zhang Guo-ming." Thus, even two noun phrases refer to the same person (such as the case of Zhang Guo-ming and Zhongwen xishuren above), they can substitute for each other only in an extensional context (such as those in (7) and (8)). When in an opaque context such as in (10) and (11), the sentences do not obey the law of extensionality. In other words, the substitution of one noun phrase for the other is barred.

Sometimes it is very difficult to define the intension of a proper name, say, "Zhang Guo-ming." We know that "Zhang Guo-ming" is a linguistic expression, and that its extension would be the person referred by this name. The intension of this linguistic expression would be something which relates the expression to its extension, and in this case, it would simply be a name. Thus we have three distinct functions of "Zhang Guo-ming": "Zhang Guo-ming" as a linguistic expression; "Zhang Guo-ming" as a name; and "Zhang Guo-ming" as the person referred to by that name. On the other hand, the person referred to as "Zhang Guo-ming" may

have several distinct intensions, and one of them would be the name as represented by "Zhang Guo-ming." Possible other intensions could include:

(13) a. Zhang Xiao-mei de gege.
'Zhang Xiao-mei's older brother (If Zhang Guo-ming had a sister named Zhang Xiao-mei).'

b. Zhongwen xishuren
'the chairman of the Chinese Department (If Zhang Guo-ming happened to be the chairman of the Chinese Department)'

. . .

Thus in the case of a referring phrase, we see a function from possible worlds onto individuals; given a characterization of a possible world, the function will pick out that individual which is the extension of the phrase in that world. These functions which determine extensions have been called intensions. The intension of a referring phrase , as we have seen, is a function from possible worlds onto individuals. The intension of a sentence, which is an expression whose extension is a truth value, will be a function from possible worlds onto truth values. And the intension of a predicate, which is an expression whose extension is a set of individuals (or a set of ordered pairs of individuals, etc.) will be a function from possible worlds onto such sets.

What about the extensions and intensions of the so-called deictic terms? Consider the following expressions for example:

(14)

wo	'I'
ni	'you'
jintian	'today'
jeir	'here'
. . .	

These terms do not have definite extensions. If you say "wo", its extension would be "you", if John says "wo" its extension would be "John". Likewise, if we say "jintian" today, its extension would be "today", if we said "jintian" yesterday, its extension would be "yesterday". Such is the case too with "jeir" or "nar"; their extensions would depend upon the location where the expression is uttered. The intensions of these expressions would be the functions from possible worlds onto their respective entities. And sentences containing these terms are sometimes true and sometimes false; for example:

(15) Jintian shi xinqiwu.
'Today is Friday.'

(16) Wo hen youqian.
'I am very rich.'

(17) Jeir shi yige Zhongguo fanguar.
'This is a Chinese restaurant here.'

(15) is true if this utterance is spoken on a Friday, otherwise it is false. (16) is true if the person who utters this sentence is rich, and false if the person who utters this sentence is not rich. (17) is true if the person who utters this expression is physically in or near a Chinese restaurant, and false if the expression is uttered in or near a place other than a Chinese restaurant.

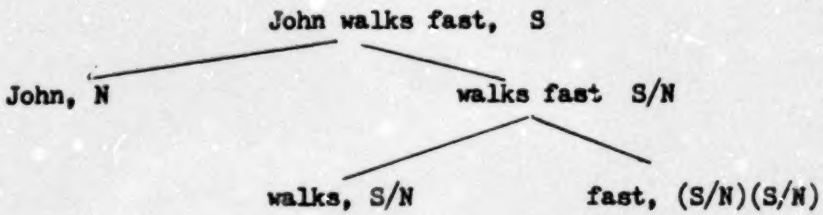
Some linguists have treated the notion "intension" as a term equivalent to "meaning" or "sense". The above discussion demonstrates that "intension" is a better choice for describing deictic terms since it indicates a function to relate a linguistic expression to its extension, and thus

avoids the dilemma of claiming that these deictic terms have the same meaning while they could have totally different extensions.

4. INTENSION USED EXTENSIONALLY

We have already showed in the previous section that some predicates require a pure extensional context and that others may have an intensional context. It follows then that a pure extensional grammar will be insufficient to account for those linguistic expressions in intensional contexts. However, this difficulty will disappear if extension can be replaced by intension which is basically a function from possible worlds onto individuals or truth values. To deal with both situations in a uniform way, Montague (1974) suggested that, in all contexts, names and sentences have as extensions individual concepts and propositions respectively. Out of context when they are isolated, they have as extensions their normal extensions. Since all other categories through their functional character are dependent on sentences and names, this means that all derived categories now have as their extension a function from the intension of the argument of the functional category. On the basis of the Fregean principle, Montague was thus able to develop an intensional grammar in which semantic units nearly match their respective syntactic units on a one-to-one basis. And the syntactic units are derived in terms of a categorial grammar. The following is an example:

(18)



A standard categorial grammar is a phrase structure grammar of a particular sort. Certain syntactic categories are designated as basic---e.g. N, and NP, and S. A category like Verb Phrase, which is something that combines with an NP to give an S, is named accordingly S/NP, a determiner would be NP/N (combines with N to give NP); an adjective would be N/N; a verb phrase adverb (S/NP)(S/NP), etc. The phrase structure rules are determined by the names of the categories---e.g. if there is a category S/NP, there must be a phrase structure rule like (19):

(19) S ⟶ S/NP + NP (or S ⟶ NP + S/NP)

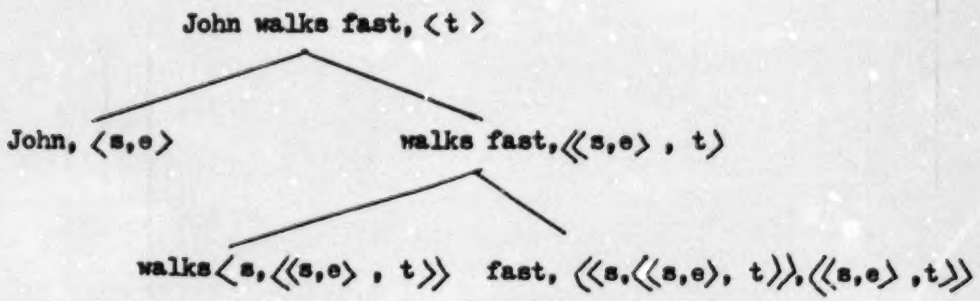
Just as we do with syntax, we will now construct all the intensions and extensions of all other expressions on the basis of names and sentences. The extension of any derived type will be a function from the extension of one type to the extension of another. Take the verb 'walks' for example, its extension will be a function from the extension of a name to the extension of a sentence.

(20)

where "e" stands for the extension of "john" and "t" the truth value of the sentence. Thus "walks" would be a function from "e" to "t", written as e,t . In an intensional grammar, "John" would be represented as s,e ("s" stands for sense here), the sentence as s,t , and the verb

as $\langle s,e \rangle$, t . The semantic derivation would be something like the following:

(21)



We can clearly see the parallelism between syntactic and semantic structure. This is a greatly simplified example of intensional grammar as posited by Montague. Consult Montague (1974) for detailed analysis.

5. CONCLUSION

In this short paper we have examined the two logical notions of "intension" and "extension", particularly in terms of Chinese examples. We have found that they are not only useful in explaining certain problems concerning meaning, but cogent in building up a formal semantic structure parallel to formal syntax as represented by categorial grammar. Some problems still remain; for example these notions seem to deal with only declarative sentences. Explanations are needed for idiomatic usages which cannot be accounted for in terms of the Fregean principle, as well as for contextual situations which turn a normal sentence into a satirical one. Nevertheless, intensional grammar has provided a very important first step, i.e. a formal semantic structure. It certainly seems to be a very promising avenue for penetrating the mystery of meaning.

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